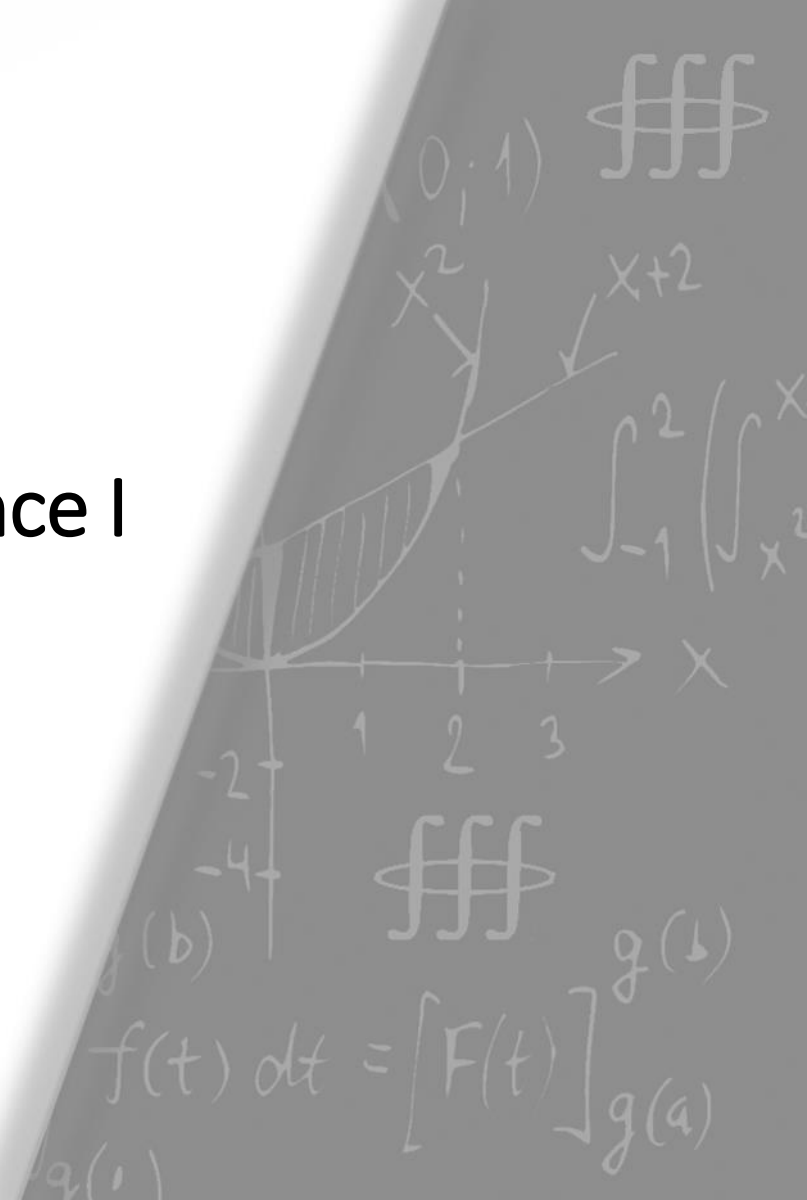




# ITRI616 – Artificial Intelligence I

*Vaal Triangle*



# Tonight

- Logical Agents, the basic architecture
- Agents and their environments
- Classifying environments
- Neural Networks continued (now in Python)

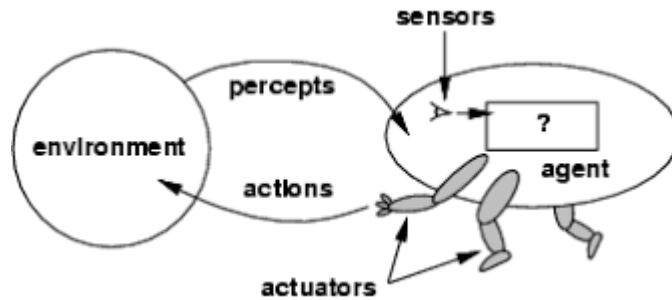
# The Agent

- Agents are a kind of design pattern that help us to view the AI as an actor inside of a system/environment
- You have actually already seen such an environment, but let us explore this further.

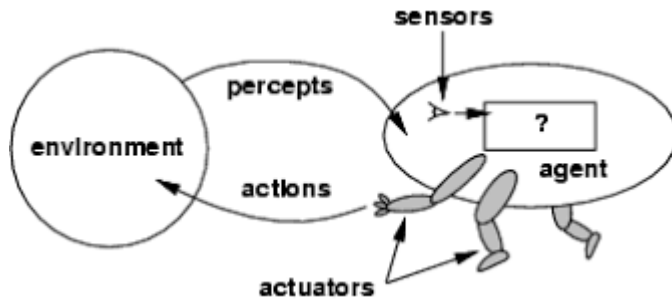
# The Agent and it's Environment

- An agent exists in an environment
- It senses things about the environment (Precepts)
  - Sensing is done through sensors/input
- And makes changes to itself and its environment (Actions)
  - Actions are done through actuators/output

# The Agent and it's Environment



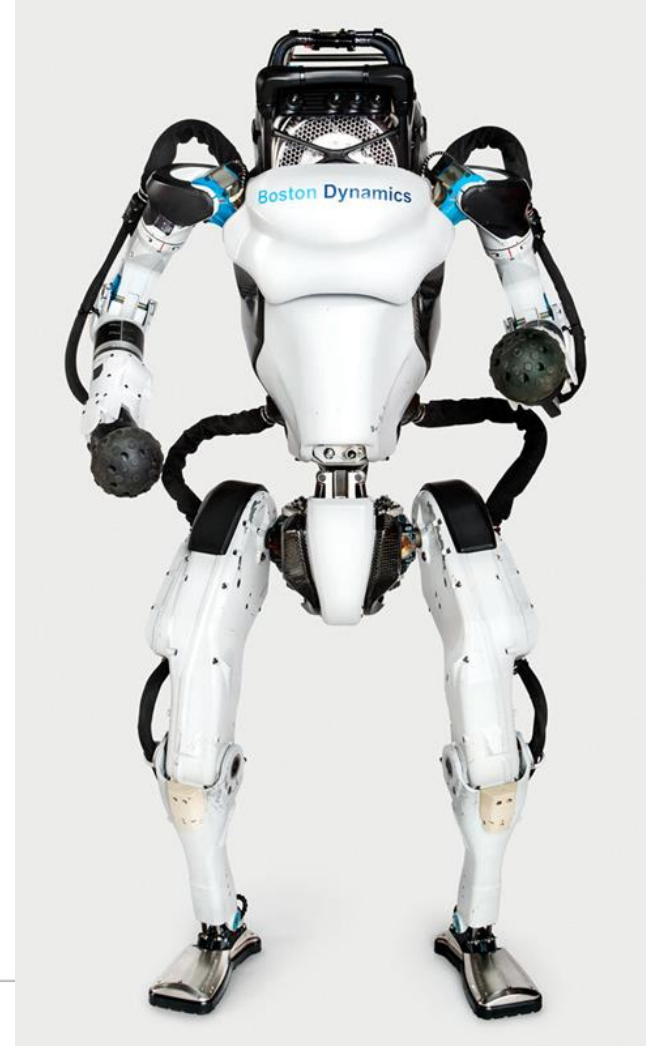
# The Agent and it's Environment



- Example – Atlas



# The Agent and it's Environment



# The Agent and it's Environment

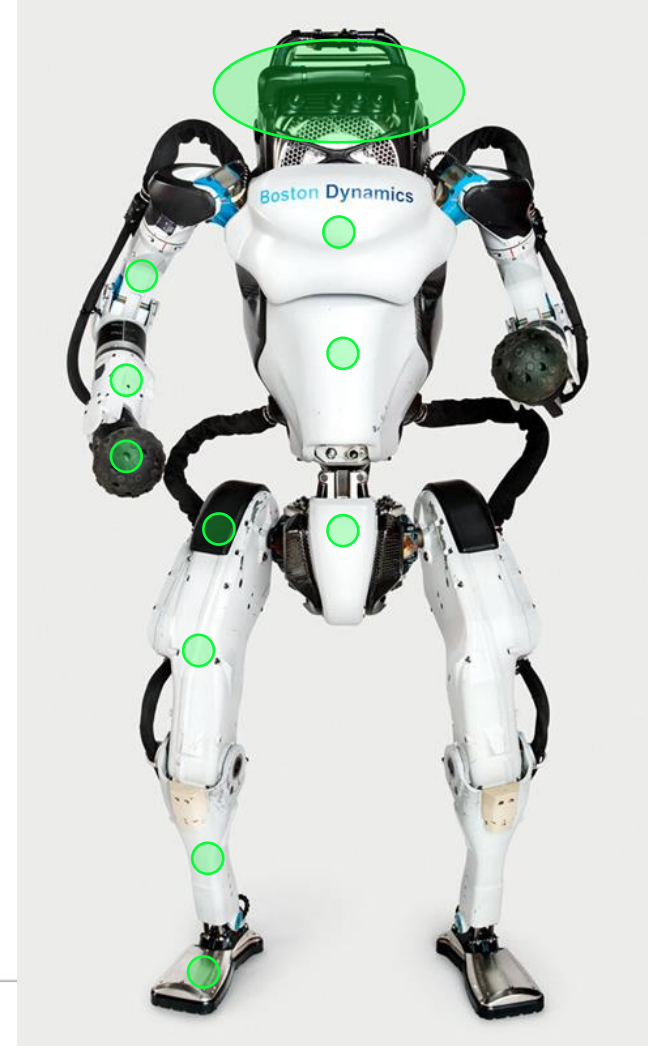
- Actuators (2013 specifications)
  - 28 degrees of freedom (Electric and Hydraulic)





# The Agent and it's Environment

- Actuators (2013 specifications)
  - 28 degrees of freedom (Electric and Hydraulic)
- Sensors
  - LIDAR
  - Stereoscopic vision
  - Accelerometers
  - Gyroscopes
  - Etc.



# The Agent and it's Environment

- Actuators (2013 specifications)
  - 28 degrees of freedom (Electric and Hydraulic)
- Sensors
  - LIDAR
  - Stereoscopic vision
  - Accelerometers
  - Gyroscopes
  - Etc.
- The environment is the context it finds itself in:

<http://gazebo-sim.org/>

[http://gazebo-sim.org/tutorials?tut=drsim\\_atlas\\_robot\\_interface&cat=drsim](http://gazebo-sim.org/tutorials?tut=drsim_atlas_robot_interface&cat=drsim)

[https://www.youtube.com/watch?v=A9esE5R3n\\_I](https://www.youtube.com/watch?v=A9esE5R3n_I)



# The Agent and it's Environment

- Imagine now interchangeable AI agents in a chess game
  - Inputs – the board state
  - Actions (output return) – the move to be made

# The Agent and it's Environment

- Imagine now interchangeable AI agents in your chess game
  - Inputs – the board state
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- The thinking part could be a search algorithm and static evaluation or a neural network based system – all through the agent interface.

# The Agent and it's Environment

- Imagine now interchangeable AI agents in your chess game
  - Inputs – the board state
  - Actions (output return) – the move to be made
- The thinking part could be a search algorithm and static evaluation or a neural network based system – all through the agent interface.
- In chess this is UCI:
  - <https://www.shredderchess.com/chess-info/features/uci-universal-chess-interface.html>
  - <https://www.shredderchess.com/chess-download/info-download.html>

# Industrial Robots

- Industrial programmable robots are used for repetitive manufacturing tasks



# Industrial Robots

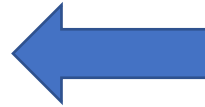
- They are generally programmed like other industrial machines with G-code



# Industrial Robots

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638 G02 X33.171944 Y70.454862 Z-0.050000 I3.146309 J-33.690888
639 G02 X36.600000 Y69.507031 Z-0.050000 I-1.004582 J-10.306423
640 G02 X38.104729 Y68.492243 Z-0.050000 I-2.584564 J-5.455393
641 G02 X39.011809 Y67.286112 Z-0.050000 I-2.828059 J-3.071018
642 G02 X39.331246 Y66.514942 Z-0.050000 I-5.323865 J-2.657010
643 G02 X39.807199 Y64.905525 Z-0.050000 I-22.763254 J-7.606872
644 G02 X40.177928 Y63.253731 Z-0.050000 I-25.737692 J-6.644065
645 G02 X40.767720 Y59.882203 Z-0.050000 I-106.718161 J-20.405906
646 G03 X41.575635 Y54.882646 Z-0.050000 I900.292941 J142.919939
647 G03 X41.596655 Y54.841610 Z-0.050000 I0.074477 J0.012248
648 G01 X41.616504 Y54.840865 Z-0.050000
649 G03 X43.832193 Y56.902860 Z-0.050000 I-237.748889 J257.691322
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654 G02 X46.748493 Y58.124940 Z-0.050000 I-0.068315 J0.021020
655 G02 X44.293003 Y55.813775 Z-0.050000 I-522.960908 J553.158477
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660 G01 X42.197709 Y51.694954 Z-0.050000
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663 G02 X63.838961 Y45.438448 Z-0.050000 I-11.729341 J-38.334901
664 G02 X71.346855 Y38.826978 Z-0.050000 I-18.670215 J-28.770305
665 G02 X75.133285 Y32.095385 Z-0.050000 I-15.602289 J-13.206781
666 G02 X75.630257 Y30.300412 Z-0.050000 I-16.928676 J-5.653304
667 G02 X75.868172 Y28.776325 Z-0.050000 I-11.951813 J-2.646331
668 G03 X75.951985 Y28.284115 Z-0.050000 I3.239037 J0.298300
669 G03 X76.001090 Y28.245795 Z-0.050000 I0.049105 J0.012303
670 G03 X76.050678 Y28.254190 Z-0.050000 I0.000000 J0.150648
671 G03 X76.726523 Y28.498604 Z-0.050000 I-10.207675 J29.282525
672 G01 X76.726571 Y28.498313 Z-0.050000
    
```



G-code



# Industrial Robots

```

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671 G03 X76.726523 Y28.498604 Z-0.050000 I-10.207675 J29.282525
672 G01 X76.726571 Y28.498313 Z-0.050000

```

- Also used on:
  - 3d printers
  - Milling machines
  - Lathes
  - Etc.

# Industrial Robots

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```

- This is NOT the robotics we are talking about though, but it is important to have at least some knowledge of this.

# Robotics – embedded engineering

- The robotics we are talking about grew out of the field of embedded engineering and industrial engineering.

# Robotics - IOT

- The robotics we are talking about grew out of the field of embedded engineering and industrial engineering.
- Closely related to robotics in this sense of the word is the field of IOT (Internet of Things)

# Robotics – Tool chains

- The robotics we are talking about grew out of the field of embedded engineering and industrial engineering.
- Closely related to robotics in this sense of the word is the field of IOT (Internet of Things)
- There are a wide variety of tool chains and systems that can be explored, in this instance, I would like to explore Arduino and its ecosystem.

# Arduino



- Simplest of the platforms to get started with (although microbit is also really good)

# Arduino



- Simplest of the platforms to get started with (although microbit is also really good)
- Based on a microcontroller not a processor!



# Arduino



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- Runs headless



# Arduino



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- 13 digital IO pins

# Arduino



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- Based on a microcontroller not a processor!
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- 13 digital IO pins
- 6 analog IO pins

# Arduino



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- 6 PWM pins

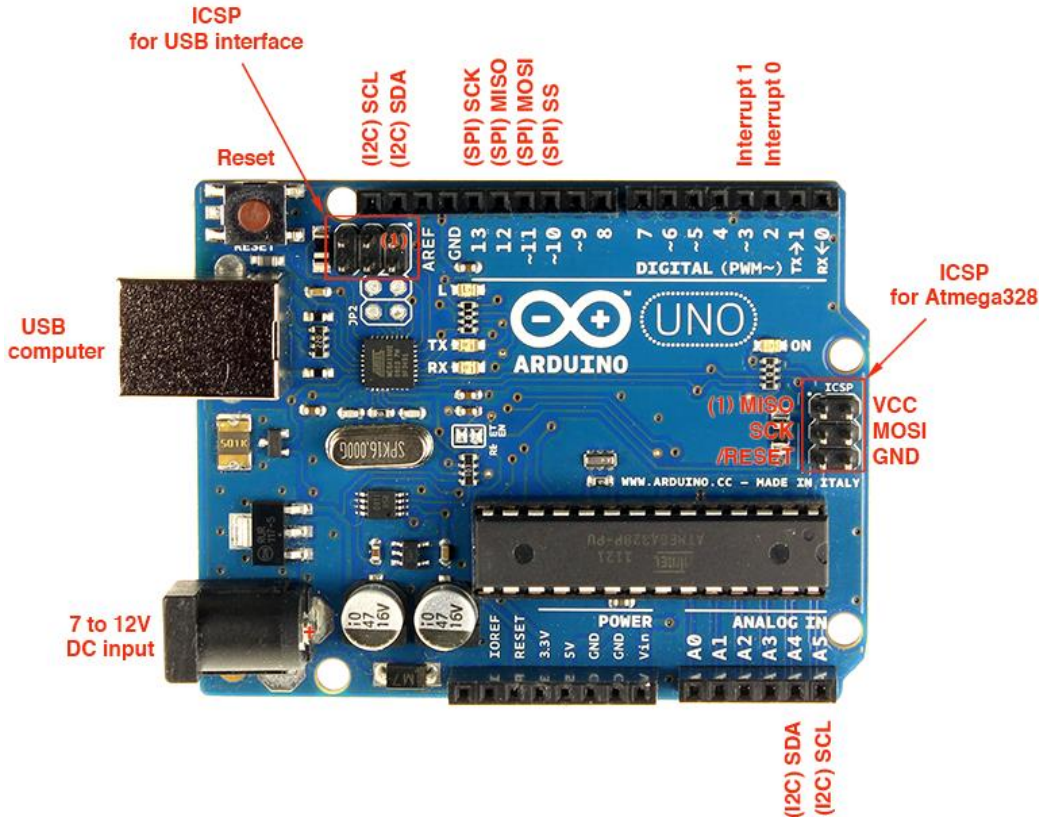


# Arduino



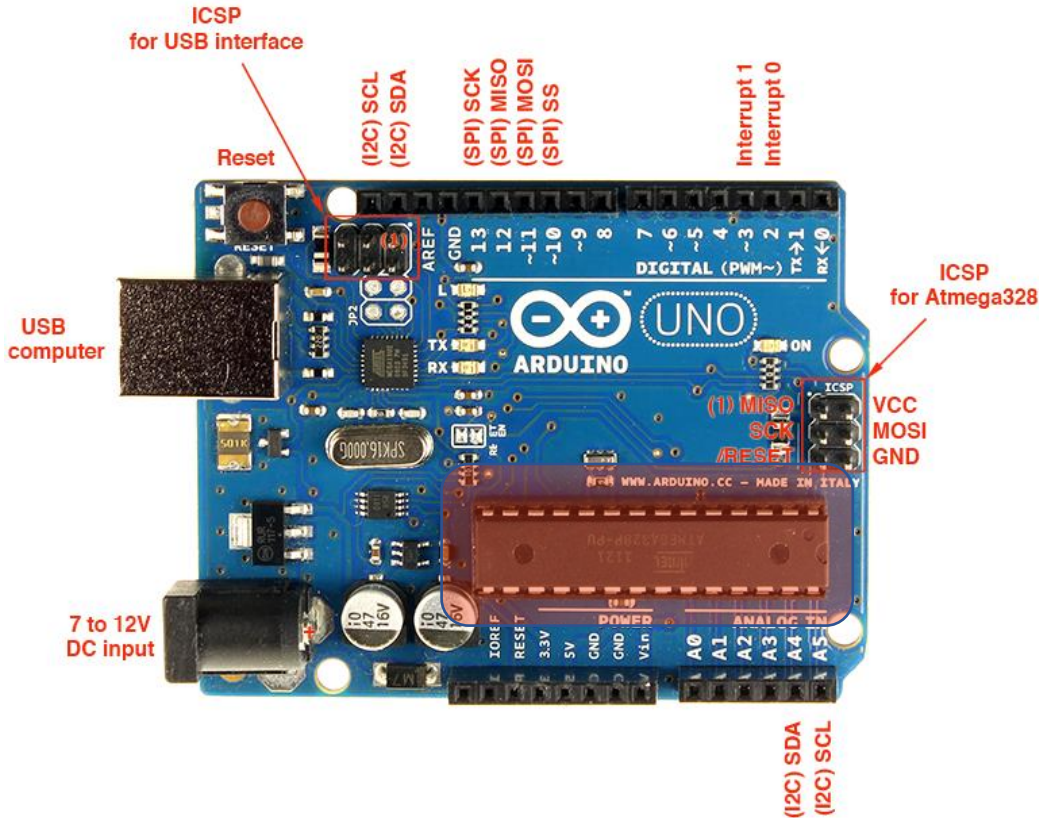
- Simplest of the platforms to get started with (although microbit is also really good)
- Based on a microcontroller not a processor!
- Runs headless
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- 6 analog IO pins
- 6 PWM pins
- UART, I<sup>2</sup>C, SPI

# Arduino



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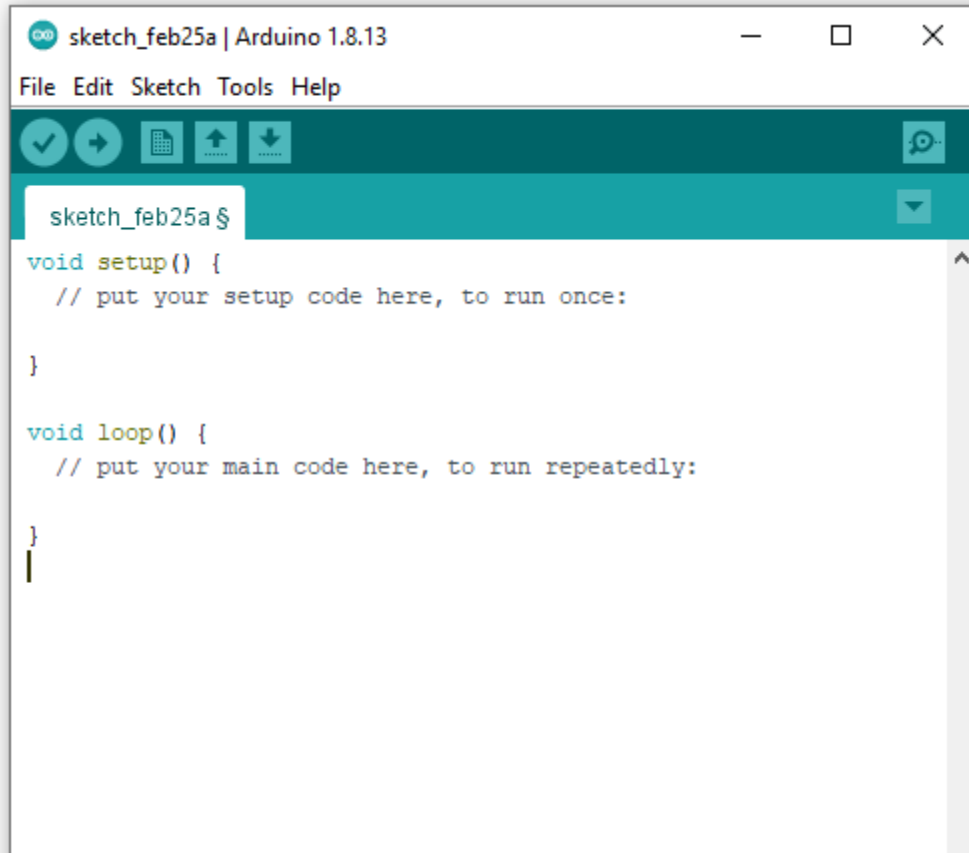
# Arduino



- Almost everything sits here!

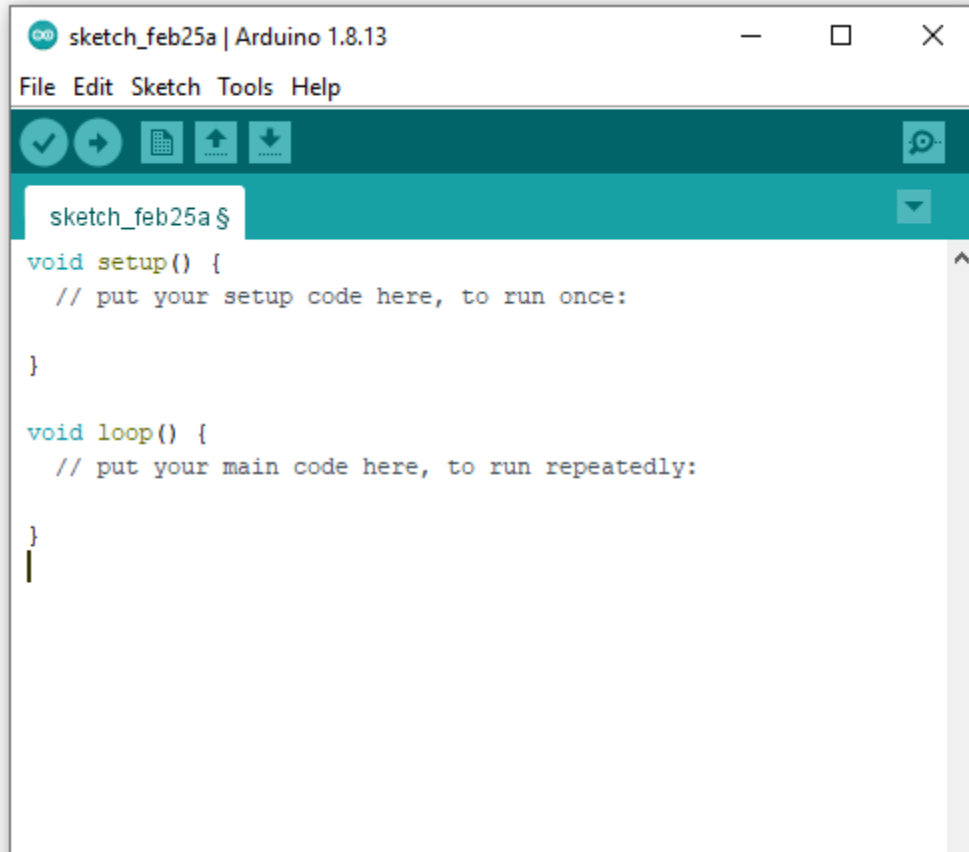


# Arduino - IDE



- Setup / Loop

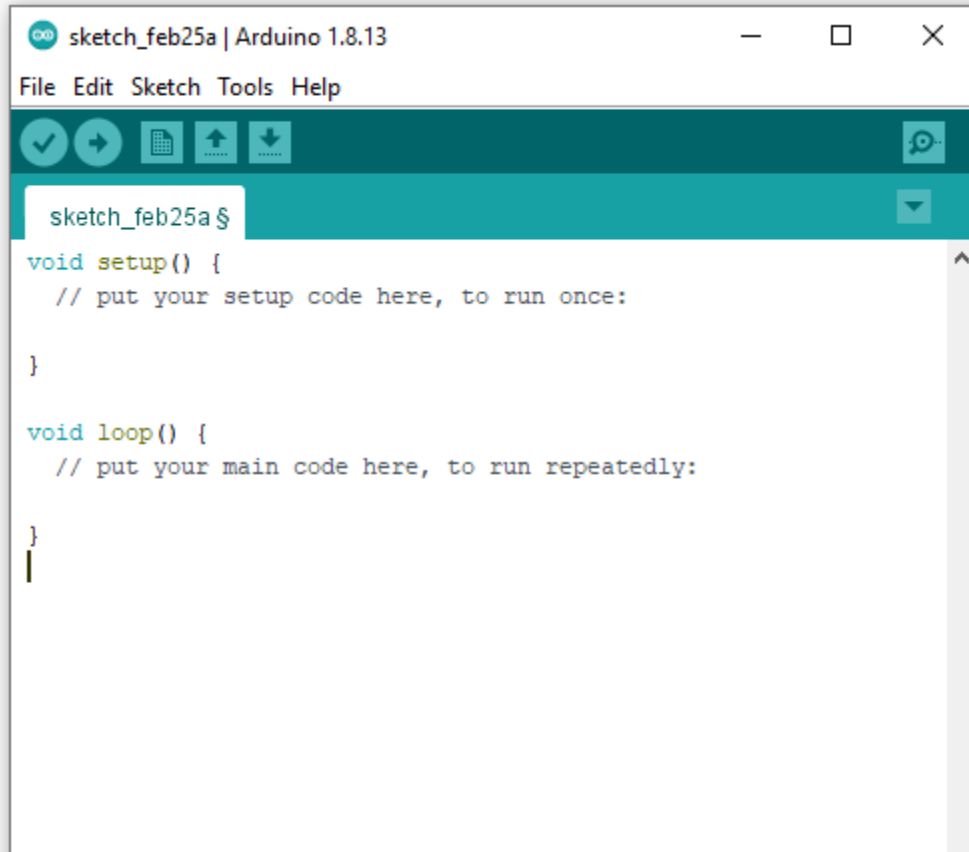
# Arduino - IDE



- Setup / Loop
- Very simple library system



# Arduino - IDE



- Setup / Loop
- Very simple library system
- Built in com port monitor

# Shopping!

- Sensors
- Actuators
- Controller boards
- Mechanical components

# Shopping!



<https://www.pishop.co.za/store/>

- Sensors
- Actuators
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# Shopping!



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<https://www.pishop.co.za/store/>



<https://www.pishop.co.za/store/>



<https://www.mantech.co.za/>

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# Shopping!



<https://www.pishop.co.za/store/>



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<https://www.diyelectronics.co.za/>

# Shopping!



- Sensors
- Actuators
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# Shopping!

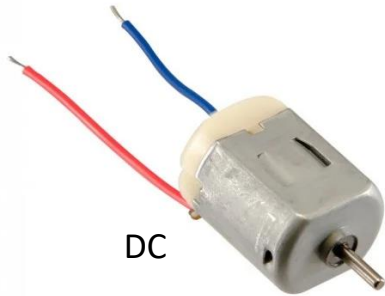


- Sensors
- Actuators
- Controller boards
- Mechanical components





# Shopping!



DC



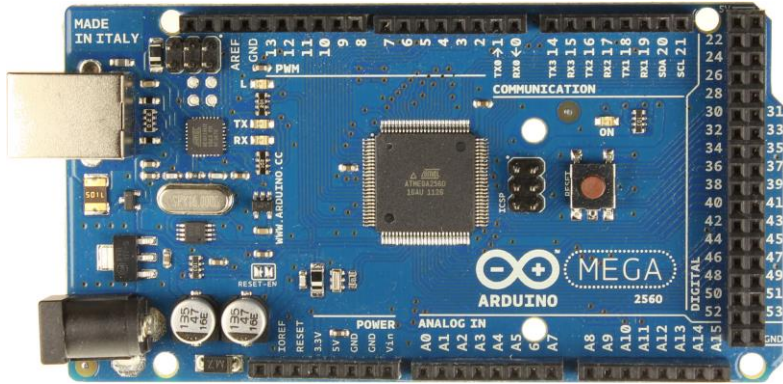
servo

- Sensors
- Actuators
- Controller boards
- Mechanical components



stepper

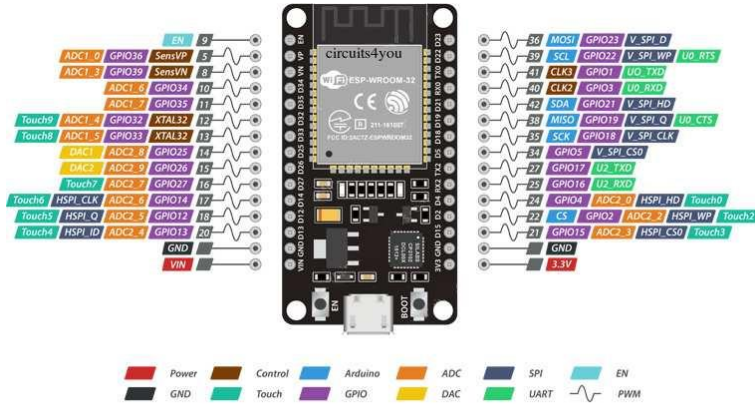
# Shopping!



Arduino Family

- Sensors
- Actuators
- Controller boards
- Mechanical components

# Shopping!

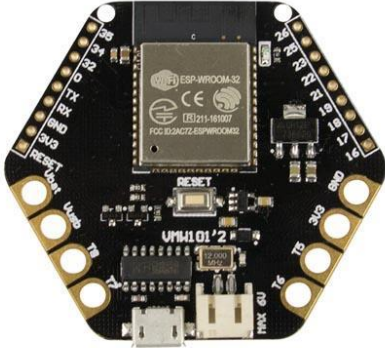


ESP32 Dev. Board Pinout

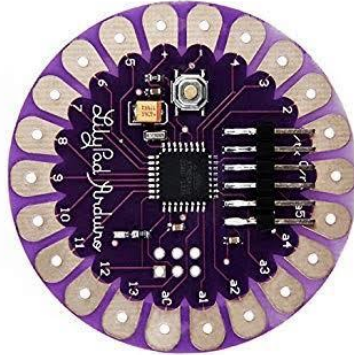
ESP32 family

- Sensors
- Actuators
- Controller boards
- Mechanical components

# Shopping!

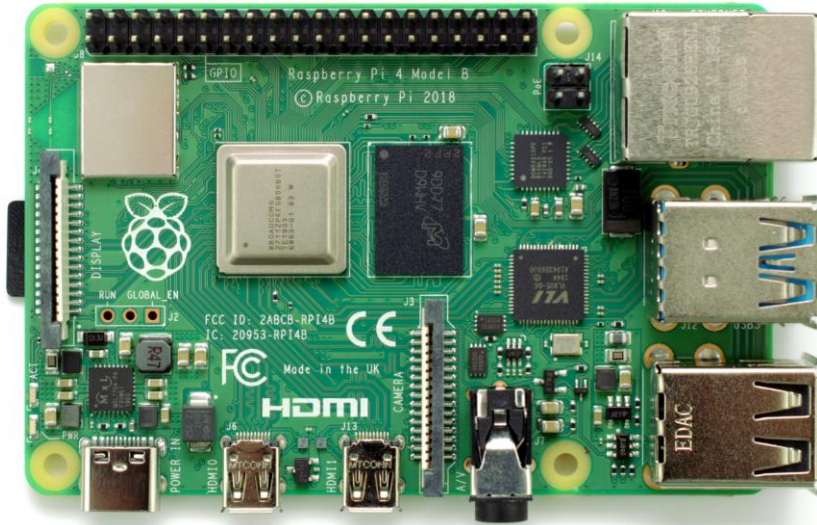


wearables



- Sensors
- Actuators
- Controller boards
- Mechanical components

# Shopping!



Microcomputers (Raspberry Pi)

- Sensors
- Actuators
- Controller boards
- Mechanical components

# Shopping!



- Sensors
- Actuators
- Controller boards
- Mechanical components

# Shopping!



- Sensors
- Actuators
- Controller boards
- Mechanical components



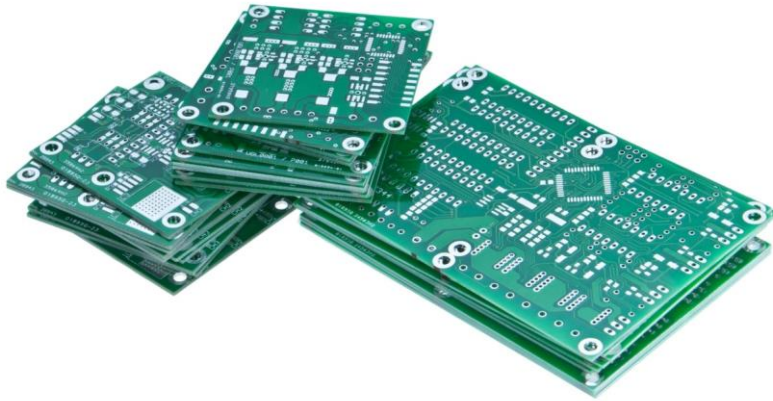
# Volume



- Sensors
- Actuators
- Controller boards
- Mechanical components



# Volume



- Sensors
- Actuators
- Controller boards
- Mechanical components
- Custom designs

# Conclusions

- We learned tonight about agents and what they consist of
  - We discussed agents in their environments
  - We discussed the nature of environments
  - We explored the robotics ecosystem a bit
- 
- Please read Chapter 1 in Russel and Norvig
  - Please read chapter 1 of Grokking deep learning

# Next week

- We start with the content in the first chapters now that orientation is complete!